

PROTECTIVE APPARATUS FOR VEHICLES**Field of the invention**

5 This invention relates to protective apparatus for vehicles. It has particular, although not exclusive application to protective devices for the cabins of passenger vehicles, and especially those used in military applications. The background to the invention will therefore be described with particular reference to the military applications to which it is particularly (although not exclusively) suited.

Background to the Invention

10 In many military operations, it is important to be able to use vehicles whose primary purpose is to assist in transporting personnel safely, rather than for the primary purpose of being engaged in combat or hostilities. One of the problems with transporting personnel in areas where military hostilities are occurring, is the potential threat of land mines, bombs or similar devices exploding when a vehicle passes over them, and thereby causing injury or death to the
15 occupants of the vehicle. Even where a vehicle is specifically designed for use in hostilities (eg. tanks and the like), the explosion of a land mine or a similar detonating device as the vehicle passes over it always entails the serious risk of injury or loss to life to its occupants. Where a military truck or a similar vehicle passes over a land mine, the occupants of the vehicle are at particular risk, as
20 such vehicles are frequently not designed specifically to withstand the impact of an explosion generated by a land mine or a similar exploding device.

25 This problem has recently become heightened, through international concerns about the activities of terrorists and terrorist organisations. Apart from the need to have vehicles which can safely transport people in a military context, there are many other situations in which it would also be desirable to have a vehicle which could more safely be used to transport people, where a risk exists that a bomb or an exploding apparatus of some other sort might be located in the ground surface over which the vehicle may pass.

The present invention aims to address this need.

General disclosure of the invention

The invention generally provides a protective apparatus for a vehicle, the apparatus comprising a generally convex structure fitted to the vehicle that is capable of resisting a force applied to the structure, in which the apex of the structure is disposed generally in a direction that is opposed to the direction of travel or movement of the force applied to the structure.

In a preferred embodiment, the structure is integrally formed as part of the vehicle. In this aspect of the invention, it is particularly preferred that the structure is located in or near to the part of the vehicle in which passengers and/or the driver are housed. In a particularly preferred embodiment of the invention, the part of the vehicle in which the driver and/or passengers are housed takes the form of a cabin or a like enclosure which is designed to house one or more of (a) the driver of the vehicle, (b) one or more other passengers and (c) controlling apparatus for the vehicle. In a particularly preferred embodiment, the structure is integrally formed as part of the vehicle's cabin, and is fitted to the underside of the cabin so that the apex of the structure generally points downwards towards the ground.

Alternatively, the structure may take the form of an accessory which is fitted to the vehicle, so as to resist a force applied to a region of the vehicle in which the driver and/or one or more passengers is (or are) housed.

In one embodiment of the invention, the structure may have a generally arcuate form, when viewed in cross-section or from another side elevation (eg, when viewed in end-section). In other embodiments of the invention, the cross-sectional profile of the structure is more angular. In a particularly preferred embodiment of the invention, the cross-sectional profile is triangular or quasi-triangular. In some embodiments of the invention however, the cross-sectional profile could be trapezoidal or frusto-trapezoidal. The cross-sectional shape adopted in any particular instance will depend, upon other factors, on the particular use to which the vehicle is to be put.

The vehicle to which the structure is fitted could transport one or more than passengers, including the driver. The vehicle could also be primarily designed for transporting personnel, or alternatively, it could be primarily designed for use in actual hostilities, as desired in any particular instance. In yet other embodiments of the invention, the vehicle could be designed so as to combine both these functions.

Detailed description of preferred embodiments of the invention

Preferred embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, in which:

Fig 1	represents a side view of a passenger cabin for a vehicle, the cabin having been constructed in accordance with the present invention;
Fig 2	represents a front view of the cabin depicted in Fig 1;
Fig 3	represents a rear view of the cabin depicted in Figs 1 & 2;
Fig 4	represents a front view of the cabin depicted in Figs 1-3 mounted on a 'Unimog' vehicle for use in military operations; and
Fig 5(a)	depicts a cabin constructed in accordance with the present invention, fitted on the front end of a vehicle; and
Fig 5(b)	depicts a conventional cabin for a vehicle of the kind depicted in Fig 5 (a).

Referring now to the drawings, Fig 1 represents a side view of a passenger cabin for a vehicle, the cabin having been constructed in accordance with the principles of the present invention. As will be seen from Fig 1, the cabin (generally denoted (1) in the accompanying drawings) comprises an upper portion 3 (which is adapted, in use, to receive and house one or more passengers, including the driver of the vehicle) and a lower portion (generally denoted 5). In the accompanying drawings, the exemplary cabin is shown as being a structure which is capable of being mounted onto a vehicle. In other words, in the accompanying

drawings, the cabin (1) takes the form of an accessory structure which may be fitted onto a vehicle, either permanently or in some removable manner. Ordinary persons of skill in the art would readily apprehend however, that in some instances, the cabin could be integrally formed with the vehicle.

5 In the accompanying drawings, the upper portion 3 of cabin 1 comprises a structure which may be designed to house not only a driver and/or one or more other passengers, but also, the steering and other controls for the vehicle. The upper cabin portion 3 also comprises a roof section 7, and four walls (each denoted 9 in the accompanying drawings). The upper cabin portion walls 9 also
10 comprise windows (each of these being denoted 11 in the accompanying drawings). Cabin 1 also comprises two doors (each denoted 13).

The lower portion 5 of cabin 1 comprises an apparatus (generally denoted 13, which as seen on side elevation in Fig 1, generally has a convex shape). In the embodiment of the invention depicted in Fig 1, the apparatus 13 comprises a
15 generally triangular structure (when viewed, as shown in Fig 1, in cross-section) and which culminates in an apex (denoted 15). The generally triangular structure 13 is defined by three boundaries (denoted 17, 19 and 21 respectively). Cabin 1 also includes a plurality of mounts (each denoted 23), as shown in side elevation on Fig 1). This configuration means that, as previously mentioned, cabin 1 takes
20 the form of an accessory structure which is able to be fitted onto a vehicle. Figs 4 and 5 (a) show the cabin 1 fitted onto the front end of a vehicle.

In yet other embodiments of the invention, a protective apparatus constructed in accordance with the principles of the present invention could take an arcuate shape when viewed in cross-section or end-section. Such alternative
25 shapes are apprehended by the concept of the invention.

When cabin 1 is fitted to a vehicle in a manner of the kinds previously mentioned, if the vehicle travels over a ground surface which contains a land mine, a bomb or another detonating device, the generally convex (and in the embodiments shown in the accompanying drawings, triangular) cross-sectional
30 profile of the apparatus 13, is such that any force applied to the apparatus 13 by

the land mine, bomb or detonating device would at least to some extent, generally be dispersed or deflected away from the apparatus, by virtue of its shape. In contrast, and having regard more particularly to the type of conventional vehicle cabin shown in Fig 5(b), a conventional vehicle cabin for use in military operations typically comprises a generally flat underneath surface, which would absorb the entirety of the impact of an explosion caused by a bomb, land mine or other detonating device that explodes underneath the cabin.

In the case of a conventional cabin, the cross-sectional profile of the underneath of the cabin is such that the entire impact (or a significant part of the impact) is generally absorbed by the cabin, and frequently, this means that the force applied to the underneath of the cabin will rupture it, resulting in personnel travelling within the cabin being subjected to that force. The net effect of this is to result in death or bodily injury to the occupants of the cabin.

The apparatus 13 of the present invention may be constructed so as generally to have the cross-sectional triangular profile (or another convex profile) of the kind shown in Fig 1. As shown more particularly in Figs 2 and 3 however, the cabin 1 may be designed so that it in fact comprises two generally triangular structures (each denoted 13(a) and 13(b) in Figs 2 and Fig 3 respectively), and a bridging portion (denoted 25) in those drawings. In the embodiment shown in Figs 2, 3 and 5(a), the configuration of the two triangular mounts (13(a) and 13(b), respectively) and the bridging portion is such as to enable the cabin 1 to be fitted conveniently to a chassis or other structure that defines the remainder of the vehicle. Persons of skill in the art would readily apprehend however, that the particular constructional details depicted in Figs 1 to 5(a) inclusive is merely one example of a mounting structure for a vehicle cabin constructed in accordance with the invention, and that many other possibilities are bound within the scope of the invention, without departing from the inventive concept.

The apparatus 13 of the present invention may be constructed from any of a number of suitable materials. Materials suitable for this purpose would readily be known to persons skill of the art, and would include various metallic materials that are known to have superior resistance to the impact of explosions. These

materials would specifically include high ductile steels and materials with similar force or impact-resistant properties. In a particularly preferred construction, all the joins and any surfaces which contain a bend are formed so as to be impervious to the impact of an explosion or detonation. The construction of joins or joints on a cabin made in accordance with the invention (and particularly, the joins/joints on a protective apparatus according to the present invention) could be achieved by any of a number of methods, the nature of which would be understood by ordinary persons of skill in the art. One particularly suitable way of constructing such joins or joints would be to use a continuous seam weld along the join/joint, and additionally, to apply a capping materials (typically also high ductile steel) along the seam weld.

The non-windowed elements of the upper portion (designated 3 in the accompanying drawings) of the cabin could also be made from any number of suitable materials. In general, those elements (as indeed also the windows themselves) would need to be bullet-resistant, in most military applications, especially where it is envisaged that the vehicle might be required to travel through areas where hostilities might be in progress. In such applications, the non-windowed elements could desirably be made from high tensile steels or materials with similar force or impact-resistant properties.

Vehicles fitted with either:

- (a) a cabin which has an integrally formed protective structure; or
- (b) an accessory protective structure

constructed in accordance with the present invention, could either be built *ab initio* with either of those structures, or alternatively, existing vehicles could be fitted with one or other kind of structure. In many military operations, it is also desirable to be able to assemble a vehicle on site at the place where the operations are to be conducted. The present invention is compatible with the principle of vehicles (that are to be fitted with a protective apparatus in accordance with the invention) being constructed in

parts, and later being assembled *in situ*.

Accordingly, the principles of the present invention allow for considerable flexibility in conducting military operations that may need to be carried out remotely from the place where a vehicle that is fitted with a protective apparatus in accordance with the invention, might initially have been constructed.

Persons of skill in the art would also recognise that while the protective structure has been specifically described with reference to its use as a structure fitted to an underneath compartment of a vehicle, the principles of the invention are also applicable to using structures made in accordance with its spirit and scope, in other contexts. For example, convex protective structures of the type described previously might be fitted to other parts of a vehicle, so as to protect those other parts from collateral damage caused by land mines, bombs or other detonating devices with which the vehicle might come into proximity.

The present invention is therefore capable of many modifications, and of being applied to many uses. Accordingly, the spirit and scope of the present invention is not to be limited by reference to the exemplary constructional details or uses of the embodiments described in this specification.

It is to be understood that wherever used in this specification (including in both the description and the claims), forms of the word 'comprise' are equivalent in meaning to the corresponding forms of the word 'include', and are thus not to be taken as excluding or implying the exclusion of a feature or integer.

It will be also understood that the invention disclosed in this specification extends to all combinations of two or more of the individual features mentioned or evident from or implicit in the text of this specification or the accompanying drawings. All such different combinations constitute various alternative aspects of the invention.